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ABSTRACT

The seven stages in the system development process are discussed in the context of implementing basic arithmetic drill and practice exercises on a computer-based system: (1) feasibility study; (2) requirements definition; (3) alternative specifications; (4) evaluation and selection of an alternative; (5) system design; (6) development and testing; and (7) implementation. The importance of considering the five components of a computer-based system--hardware, software, procedures, people, and data--at each stage is emphasized. A list of criteria for evaluating software is provided. (MES)

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OBJECTIVE CRITERIA FOR THE SELECTION OF SOFTWARE

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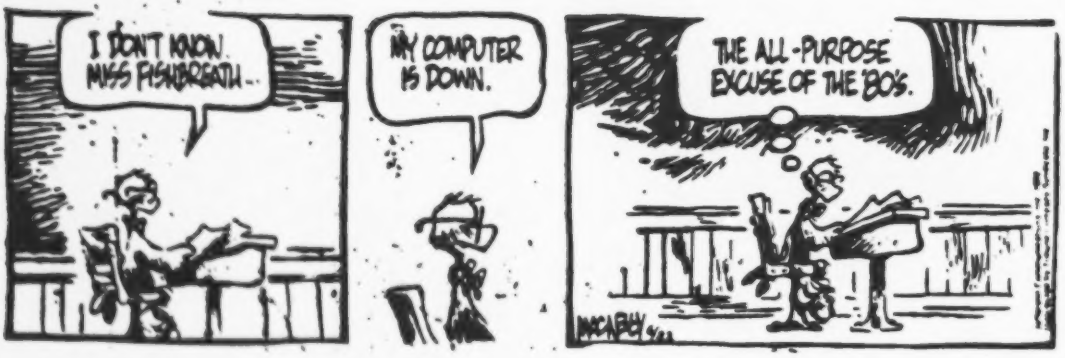

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OBJECTIVE CRITERIA FOR THE SELECTION OF SOFTWARE

INTRODUCTION

The purpose of this paper is threefold. The first is to describe how an educator can define specific software requirements in his or her own discipline. The second is to offer suggestions about which criteria are appropriate to use to evaluate software packages. The third is to provide educators and administrators with knowledge of the System Development Process.

For those who are already familiar with the System Development Process, this paper assumes that hardware is already in place. It also assumes that educators are faced with a number of problems associated with finding and evaluating educational software prior to incorporating it into the curriculum.

SYSTEM DEVELOPMENT METHODOLOGY

System developers are people who follow a prescribed methodolgy generally know as STRUCTURED SYSTEMS ANALYSIS AND DESIGN. The methodology divides the System Development Process into seven major stages; each stage has five components. System developers, while creating a computer based system, are part of the System Development Process. A diagram of the steps and components is shown in Figure 1.

FIVE COMPONENT MODEL

The five components of a computer-based system are: **hardware**, **software**, **procedures**, **people**, and **data**. The most important component is people. Computer systems serve people, increase their productivity, and stimulate their creativity. The **people** are the system developers and users. The term "users" encompasses all levels of **people** who are served by the computer-based system, such as computer operators, data entry personnel, data retrieval personnel, managers, and secretaries. In an educational context the users are the educators, administrators, staff, and students, while the system developers are the vendors of the educational software. **Hardware** pertains to the computing machinery which will be controlled by the **software** that educators will purchase to enhance learning. **Procedures** involve the instructions which detail what is to be done, who will do it, when it will be done, and how it will be done. **Data** are isolated facts which are processed into information by the computer system. The effectiveness of a computer system will be either constrained or expanded by the integration of these five components.

During each of the stages in System Development, each of the five components must be considered. A single component may be more important than the others in one stage. However, all components should be considered during each stage.

STAGES IN SYSTEM DEVELOPMENT

The first major stage is called the Feasibility Study. A Feasibility Study is conducted to determine if it is possible to solve an organization's problem, with or without a computer based system. A Feasibilty Study is limited in scope to a single problem or a set of related problems. The first task to be done in a Feasibility Study is to define the problem and give it limits. If the scope of a problem is too large, subdividing it increases the chance of developing a viable solution. To Educators, problem definition may seem inappropriate. A problem, in the System Development sense, is a perceived difference between what is and what ought to be. The need to use computer technology to improve student learning experiences in a specific subject area is a problem. This problem is broad; it should be narrowed. For example, a more reasonable problem statement would be: Elementary educators need more drill and practice exercises in basic arithmetic. The rest of the feasibility study addresses the question, "Is it feasible to implement arithmetic drill and practice exercises on a computer based system?".

Once the problem has been defined and narrowed, four types of feasibility are then considered: economic, technical, operational, and schedule feasibility. Rough cost estimates are made. Economic feasibility addresses the question "Are we committed to spending up to 50% more than the best rough estimate?". Technical feasibility is determined by the availability of the technology. Operational feasibility is determined by the ability of the organization to operate and house the computer system with reasonable efficiency. Schedule feasibility is determined by the probability that a computer system can be implemented in time to solve the problem. Although some types of feasibility may be irrelevant to a problem, all should be addressed. All five components should be considered in the Feasibility study as well.

Who does the Feasibility Study? Generally, a project team works together to determine the feasibility of solving a problem with the aid of a computer system. In the educational context, a strong project team could be composed of a few educators involved in the curriculum, an administrator who can assist in determining feasibility and constraints, and someone who is knowledgeable about the existing hardware. Some alternative persons to consider on the team for at least part of the development process might include community member who can be objective and who has some computer expertise, and a student.

If the project team has determined that it is feasible to continue the project of finding and evaluating software for use in the curriculum, the Requirements Definition stage begins.

	Seven Development Steps	Five Components of a Computer-based System				
		Hardware	Software	Data	Procedures	People
Analysis Phase	Feasibility Study					
	Requirements Definition					
	Alternative Specifications					
	Evaluation and Selection of an Alternative					
Design Phase	System Design					
Implementation Phase	Development and Testing					
	Implementation					

FIGURE 1

A MATRIX OF COMPONENTS AND STAGES
IN THE SYSTEM DEVELOPMENT PROCESS

The Stages in System Development Process actually form a dynamic cycle. If the development has been well done, the cycle will improve an already well-functioning system. If it has not been well done, the work will be redundant rather than dynamic. A knowledge of the stages can assist educators in becoming users of dynamic educational computer systems.

The purpose of the Requirements Definition stage of the System Development Process is to focus on the specific needs of the users. It is imperative that users be involved in this process. Educators, students and administrators should be interviewed by members of the project team. Some or all of the team members may also be classified as users. Obtain user input by asking for "software wishes", without reservations about any of the constraints. The collective "wish list" can be organized and prioritized into the requirements or it can be sought during the problem definition step of the Feasibility Study in order to narrow the problem definition. For example, if faculty in four disciplines wish to obtain instructional support software, the project team could subdivide the problem definition into four parts, then appoint four sub-teams to work in parallel. The sub-teams could share common information, such as the existing hardware specifications and all known constraints, then specify requirements according to individual disciplines and courses. The team organization is shown in Figure 2.

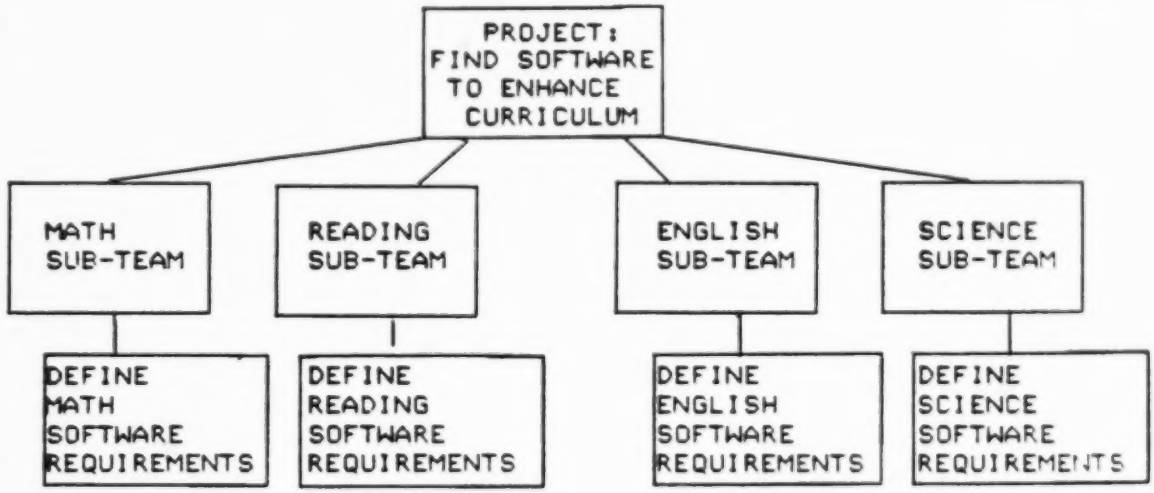

FIGURE 2

THE ORGANIZATION OF THE PROJECT TEAMS

The Requirements Definition stage can be broken into two parts: determining requirements and organizing requirements. The "wish list" will bring ideas together. From these the project team or sub-teams can specify the software goals. The project team should also verify that the other components (hardware, data, procedures, and people) are considered in specifying software goals. Initially, the goals will be idealistic. Thus, the second task is to shave the goals to a minimum. Review the requirements, both the ideal software goals and the minimum standards, with all the potential users. They will help fine tune the requirements and eliminate any internal flaws. The accuracy of the requirements is extremely important because these requirements will be used to evaluate software and to request proposals from vendors.

When the requirements are accurately defined, the project team can embark on the search for software. This is the beginning of the Evaluate and Select Alternatives stage in the System Development Process. If software goals have been developed in several disciplines, at this stage, one discipline should be selected as the pilot. Completing this stage in one subject area will provide a springboard for further refinement of requirements in all subject areas. This will save time in the long run.

Before software can be evaluated and selected, software must be found. Some sources of software: hardware vendors, educator publications, users groups, educator meetings, other schools, and other educators. Since most businesses buy hardware because it supports certain specialized software packages, vendors are generally aware of some software sources for their products. However, in the educational area, the vendor knowledge is more limited. Publications abound with advertisements providing names of vendors. Vendors can then be sent the detailed requirements list in the form of a Request for a Proposal (RFP). This RFP asks vendors to bid on software, services, supplies, or hardware. It normally includes a description of requirements and constraints. Publications, such as Electronic Education, provide lists of free educational computer software catalogs. Users groups can be located through a vendor, at educator meetings, or by contacting other schools. If no users groups are in your area, start one. A users group is a good source of advice, collective experience and even free software. A group can even influence the software vendors to develop needed packages which the educators in the group could then offer to evaluate (in return for a free copy of the software, of course).

Once the software is located, evaluation takes place in three steps. First, check the software against minimum requirements. If an article, advertisement or brochure convinces you that the software does not meet minimum requirements, reject it. For software which does pass the minimum test, demand demonstration copies. Matching extended requirements against written critiques is nearly impossible. A member of a users group might be able to provide an examination copy of a software package for a short time if vendor-supplied demonstration copies are unavailable. Some vendors allow educators to come into their shops and test software. All of these alternatives are acceptable as long as

the evaluators keep the software goals in mind throughout the process. The second step of the evaluation process involves rating the software by checklist. At least two educators (possibly from the project team) should independently rate the software. A checklist provides more quantitative data for ranking the acceptable packages. The third step in the System Development Process involves ranking and weighting the checklists according to the importance of the requirements. When sufficient packages have been quantitatively evaluated, the third step is complete. A list of criteria useful for evaluating software is given in Figure 3.

Flexibility
Documentation
    a. for training the educators
    b. for training the students
Maintenance and updates
Capacity
Cost benefit
    a. cost per student
    b. useful life of software
    c. site licenses
    d. purchasing agreements
Accuracy
Reliability
Speed
Ease of use
Compatibility
Creativity Quotient
Vendor credentials
    a. experience
    b. reputation
Vendor support
    a. cost
    b. quality
    c. warranties
acceptance criteria
warranty
frustration level
intuitive commands
content

FIGURE 3

SOFTWARE EVALUATION CRITERIA

A brief report of the evaluation process is helpful for the project team. It also provides opportunity for evaluators to add their subjective opinions about the software and serves as a learning tool for the next discipline sub-team.

Now, the Design stage begins. System developers equate design with creating detailed specifications for writing software. Since packages are being purchased, the traditional design steps are not strictly followed here. However, creating a detailed plan for how the software to be purchased will be implemented in the curriculum is essential. Preliminary planning has occurred in the prior steps whether or not the evaluators and project team realized it. Before the actual purchase, the final cut of packages should be incorporated into the curriculum. What does not fit should not be purchased.

Development and Testing in the educational environment will not mean writing software. Rather it involves testing the packages in one class, and subsequently evaluating and reporting the results. Then the decision toward full Implementation in all classes can then be made, according to the design plan.

CONCLUSION

The System Development Process is now complete. An invaluable procedural tool for future decsions involving computer based education has resulted. With time, this computer based education process can become a model for administrative and educator growth and a triumph for the educational delivery system.